Is a Finding of Significant Degradation in a 404(b)1 Analysis of the Pebble Project Scientifically Supportable?

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Background

In July 2014, an internal guidance memo regarding compensatory mitigation decisions was circulated within the Alaska District of the Army Corps of Engineers. The memo contained an analysis of impervious surface by the Hydrologic Unit Codes (HUCs) established by the United States Geological Survey (USGS) across the state of Alaska. The analysis tabulated all of the 12-digit HUCs, and a few eight- and 10-digit HUCs in Alaska that contained more than a one-percent cover of developed lands. Developed land was conservatively interpreted to be equivalent to impervious surface. For each of the HUCs with greater than one percent developed land, the additional developed land was tabulated in one-percent categories from one to five percent, if present. Footnote number 4 of the table stated: "Greater than 5% impervious surface within the watershed is one method of identifying degradation in watersheds that do not have an approved [watershed] plan." (USACE 2014).

In 2018, in response to an application by the State of Alaska for the Alaska Stand-Alone Pipeline (ASAP), the EPA prepared a "white paper" criticizing the use of thresholds of impervious surface or developed land for the purposes of determining significant degradation (EPA 2018). The ASAP application suggested that 10-digit HUCs that had less than 7.5% cover of developed lands (including the unavoidable impacts of the proposed pipeline) would not be significantly degraded and therefore not require compensatory mitigation. The EPA response, the white paper, was reviewed and approved by the researchers that developed the Impervious Cover Model (ICM), the basis for the thresholds of impervious cover that may cause degradation. Those researchers and the EPA concur that thresholds have substantial limitations because they vary with specific locations and circumstances, and therefore significant degradation could occur before lower thresholds are reached. The white paper concludes that the use of thresholds of impervious cover alone is not sufficient to determine significant degradation.

The EPA response was primarily concerned with the failure to identify significant degradation solely using a threshold of impervious cover, especially if that threshold was set too high, or if the ICM was used without the appropriate consideration of its limitations, which are numerous. The response did not consider the possibility of using an appropriate model as one argument supporting a finding of significant degradation when proposed unavoidable impacts were clearly well-above any thresholds that had been found to cause degradation. Making a finding of significant degradation at lower ranges of thresholds may be contentious, but when proposed impacts are firmly above the high end of the range, the argument that no significant degradation will occur becomes more difficult to support.

In preliminary comments on the Pebble Deposit draft DEIS, the EPA requested that an analysis of the percentages of various aquatic resources that will be unavoidably impacted be conducted on a more localized scale rather than a large-scale watershed [sic]. The response from the Corps of Engineers was that an analysis at a scale of 12-digit HUCs would greatly multiply the amount of data to convey, without providing benefit to the reader.

Here I analyze the amount of developed land that would be created by the proposed mine in the single 12-digit HUC that would contain the majority of the unavoidable impacts to aquatic resources. The analysis avoids defining a specific threshold, and it uses a scale more appropriate for the ICM to show that it is straightforward to convey data at the scale of a 12-digit HUC that benefits the reader.

Unavoidable impacts to the aquatic resources in the Groundhog Mountain 12-digit HUC
The Pebble Deposit DEIS references percentages of wetlands by type in different sizes of watersheds that will be unavoidably and permanently impacted by Alternative 1 and variants of the proposed project. Given the guidance in the 2014 memo and the history of using percentages of developed land as one method to determine degradation, this reporting suggests that the percentages will be used to inform a 404(b)1 analysis regarding the significance of the degradation of aquatic resources of the US.

The analysis of developed land or impervious cover as a method that could be used to inform a finding of significant degradation is supported by a body of scientific literature. That literature describes a range of between 2-15% cover of impervious surface in a watershed before declines in stream quality become measurable (Schueler 1994; Booth & Jackson 1997; Schueler et al. 2009; Loperfido et al. 2014). Stream quality includes physical, chemical, and biological characteristics. According to this literature, if measurable declines in stream quality are to be prevented, impervious cover somewhere between 2-15% should not be permitted in a watershed.

Thresholds for measurable declines in stream quality have been identified in many studies, although there is only one study that has been conducted in Alaska, by Ourso and Frenzel (2003). Ourso and Frenzel report that impervious cover at the lower end of the range, between 4-5%, produces measurable declines in water quality in Anchorage watersheds. This lower percentage suggests that stream quality in boreal watersheds may be more sensitive to impervious cover.

There is no parallel literature concerning specific to impacts to wetlands. However, the literature on the effects of impervious cover can reasonably be applied to wetland impacts. Since wetlands are to be avoided to the extent practicable, it is reasonable to assume that once a certain percentage of wetlands within a watershed are filled, the impervious cover in the watershed will exceed that percentage, because wetland fill is typically impervious. The USACE implicitly adopts this rationale in footnote 4 of the table in the 2014 memo cited above by tabulating developed land and not impervious cover by 12-digit HUC. Wetland fill is one type of developed land.

The studies on impervious cover have been used to develop an Impervious Cover Model (ICM) (Schueler 1994; CWP 2003; Schueler et al. 2009). A meta-analysis of 35 recent peer-reviewed and published studies concludes that the Impervious Cover Model is generally sound in predicting categories of decline in stream quality once certain percentages of impervious cover are exceeded in a watershed (Schueler et al. 2009). Among other limitations, the model is valid only over a specific range in watershed sizes (the model domain). For the ICM, this model domain is first- through third-order streams in watersheds with an area of between ~1250 and 12,500 acres (CWP 2003; Schueler et al. 2009). A large proportion of the few studies that contradicted the reliability of the ICM in the meta-analysis were conducted in watersheds too large for the model domain (Schueler et al. 2009 p 312). Therefore, to be supported by scientific findings, an analysis of impervious cover needs to be appropriately scaled to the model domain of the ICM.

The upper range of that domain is approximately equivalent to the sizes of 14-digit HUCs, which are approximately one-third smaller than the sizes of 12-digit HUCs, the size used in the internal guidance memo concerning compensatory mitigation decisions (USACE 2014). Unfortunately, in Alaska, 14-digit HUCs have not be delineated. However, an analysis can be easily performed using the scale of the 12-digit HUC even as this size of watershed lies well beyond the upper range of the model domain. However, at the site of the proposed mine, the ~35,000-acre size of the 12-digit HUC is much closer to the model domain than the ~170,000-acre 10-digit HUC watershed size, or the sizes of the much larger Mulchatna, Nushagak, or Bristol Bay basins. Use of the ICM or similar analyses at those watershed sizes is well outside the predictive capacity of the ICM.

It is straightforward to conduct the analysis at the scale of the 12-digit HUC because that is how the Watershed Boundary Data (WBD) are organized and downloaded by default from the USGS. Using the size of the 12-digit HUC produces a conservative analysis, because, unless impacts are distributed uniformly across the 10-digit HUC, higher percentages of developed land will occur within some of the smaller watersheds nested within the 12-digit HUC, at the sizes more appropriate for the model domain. Moreover, other characteristics at the site of the proposed mine, such as impoundments, groundwater draw-down, and point sources of pollution, limit the applicability of the model because factors other than impervious cover will possibly mitigate and contribute to some types of degradation. For example, impoundments could limit the physical degradation of stream channels by moderating the flashy flow regimes produced by impervious cover, while point sources of pollution and draw-down of groundwater levels can cause more degradation than predicted by the extent of impervious cover alone.

The analysis presented here focuses on the 34,693-acre Groundhog Mountain 12-digit HUC, where most of the unavoidable impacts due to the mine footprint are proposed be located. The wetland mapping of the National Wetland Inventory (NWI) was used to assess the extent of wetlands, and the mine footprint shapefile was provided by The Nature Conservancy (Figure 1).

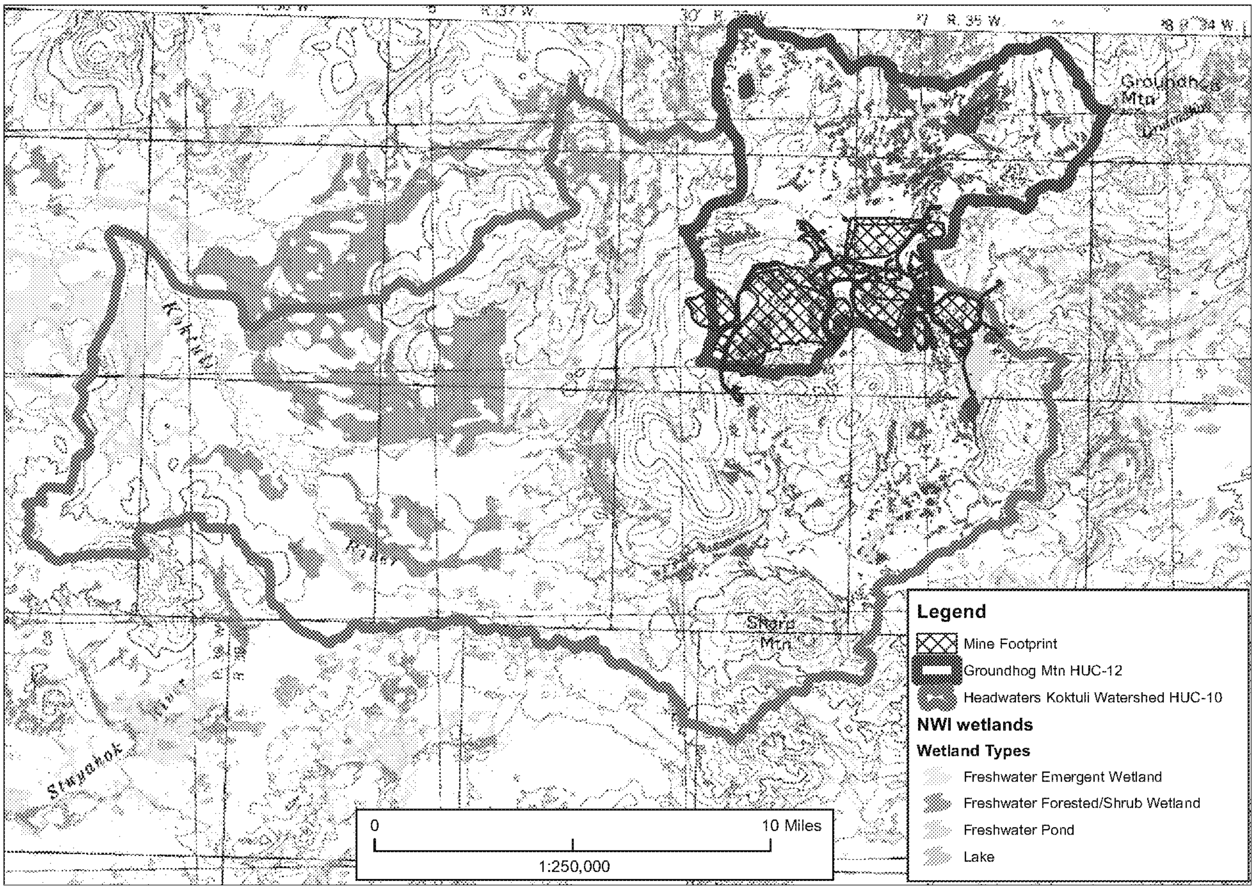

Figure 1. The 10-digit Headwaters Koktuli HUC (brown outline), the 12-digit Groundhog Mountain HUC (blue outline), NWI wetlands by type (yellow, brown, and blue), and the footprint of the proposed mine site (red hatching).

The null hypothesis of no significant degradation is examined by using the categories in the ICM. The revised ICM classifies streams within watersheds that have impervious cover between a low range of 5-10% and a high range of 20-25% as “impacted”, and in watersheds that have impervious cover between approximately 20-25% and 60-70% as “non-supporting”. Impacted streams show clear signs of declining stream health, and non-supporting streams become so degraded that it may be impossible to recover function and diversity (Scheuler et al. 2009; p 310). Above 70% streams are “Urban”.

The NWI data are assumed to be incomplete, because the DEIS shows that wetlands in the area of the proposed mine are more extensive than those mapped by the NWI. The incompleteness of the NWI mapping means that this analysis is using a subsample of the true population of wetlands. However, that subsample is assumed to represent a large portion of the total population of wetlands actually present at the site (approximately 50%). The sample is therefore sufficiently large to minimize the possibility of a type I error, the chance that the null hypothesis is rejected when it is true (in our case, concluding that there will be no significant degradation when there will be). It is also of sufficiently high power to minimize the possibility of a type II error, the chance of failing to reject the null hypothesis when it is not true (concluding that no significant degradation will occur when it will). The probability of making these errors is not quantified, nor is any dichotomous alpha-level set, below which the null will be rejected. These types of errors are only described to portray the robustness and power of the analysis relative to the hypothesis.

The analysis is conservative because it is performed in a pristine watershed at an extent nearly three times larger than the upper range of the model domain (~35,000 vs. 12,500 acres). Therefore, percentages of impacted wetlands at the scale of the 12-digit HUC should be interpreted as minimums. Some watersheds at sizes within the model domain of the ICM will exhibit larger percentages of impacted wetlands because the impacts are not uniformly distributed in the 12-digit HUC (Figure 1).

The analysis may be biased, because NWI may have failed to map some types of wetlands at a higher rate than others. The bias is presumed small because the wetland types examined are limited to just three NWI Classes (shrub/forested, emergent, and riverine), the sample size is relatively large, and the NWI map appears to show that the three wetland types are distributed more or less equally across the Groundhog Mountain watershed (Figure 1).

Results

Under alternative 1 and variants,18% of the wetlands mapped by NWI in the Groundhog Mountain HUC will be unavoidably and permanently impacted. By wetland type, unavoidable impacts will occur on 27% of the emergent (herbaceous) wetlands; 21% of the shrub-scrub wetlands; and 20% of the riverine wetlands in the HUC (the remainder of wetlands and waterbodies are classified by the NWI as ponds and lakes). All of these percentages lie well above the upper limit defining the lower range of the "Impacted" category of the ICM (10%), and most are within the lower range defining the "Nonsupporting" category (20-25%). These results from the Groundhog Mountain HUC are straightforward to convey, and they benefit the reader by showing a prediction of the significance of the degradation that will be caused by unavoidable impacts of the proposed project to the aquatic resources of the United States in the Groundhog Mountain HUC.

If watersheds were sized to match the model domain, unavoidable impacts would almost certainly exceed 50% in at least one of them, especially around the north-flowing tributary where the majority of the impacts at the mine site are proposed within the Groundhog Mountain HUC (Figure 1). Therefore, the extent of these impacts will place that watershed surrounding the tributary firmly within or above the limit of the "Nonsupporting" category of the ICM. Additionally, because 27% of emergent wetlands in the 12-digit HUC will be filled by the proposed mine, at least some functions of these aquatic resources will lie firmly in the "Nonsupporting" zone of the ICM. Moreover, this level of impact is substantially above the 5% value for a 12-digit HUC cited in the 2014 guidance memo as "one method to determine degradation" (USACE 2014). Together, these findings strongly support the rejection of the null hypothesis of no significant degradation.

Moreover, degradation of aquatic resources in the Groundhog Mountain HUC would be regionally and globally significant. Groundhog Mountain is one of only eight 12-digit headwater HUCs that support four or more species of Pacific salmon in the Nushagak River

Basin, one of the most productive basins for sockeye salmon in the world (DEIS page 3.6 1 & 2). Here the term headwater is used in its original, geologic sense (e.g. in Neuendorf et al. 2005) and not the more recent coinage of fisheries biologists (e.g. in Colvin et al. 2018). Coho, chinook, sockeye, and chum salmon were all reported in the Groundhog Mountain HUC in the Anadromous Waters Catalog, compiled by the Alaska Department of Fish and Game. These four species of Pacific salmon are supported in only seven other 12-digit headwater HUCs of the 8 million-acre Nushagak River basin; and one of those others will also be impacted by the proposed mine (Fig. 2). Moreover, the Groundhog Mountain HUC contains a disproportionately large amount of those headwater streams supporting four species of Pacific salmon. Groundhog Mountain HUC contains nearly one-third (31%) of the length of headwater streams mapped by the Anadromous Waters Catalogue in the Nushagak Basin that support four species of Pacific salmon.

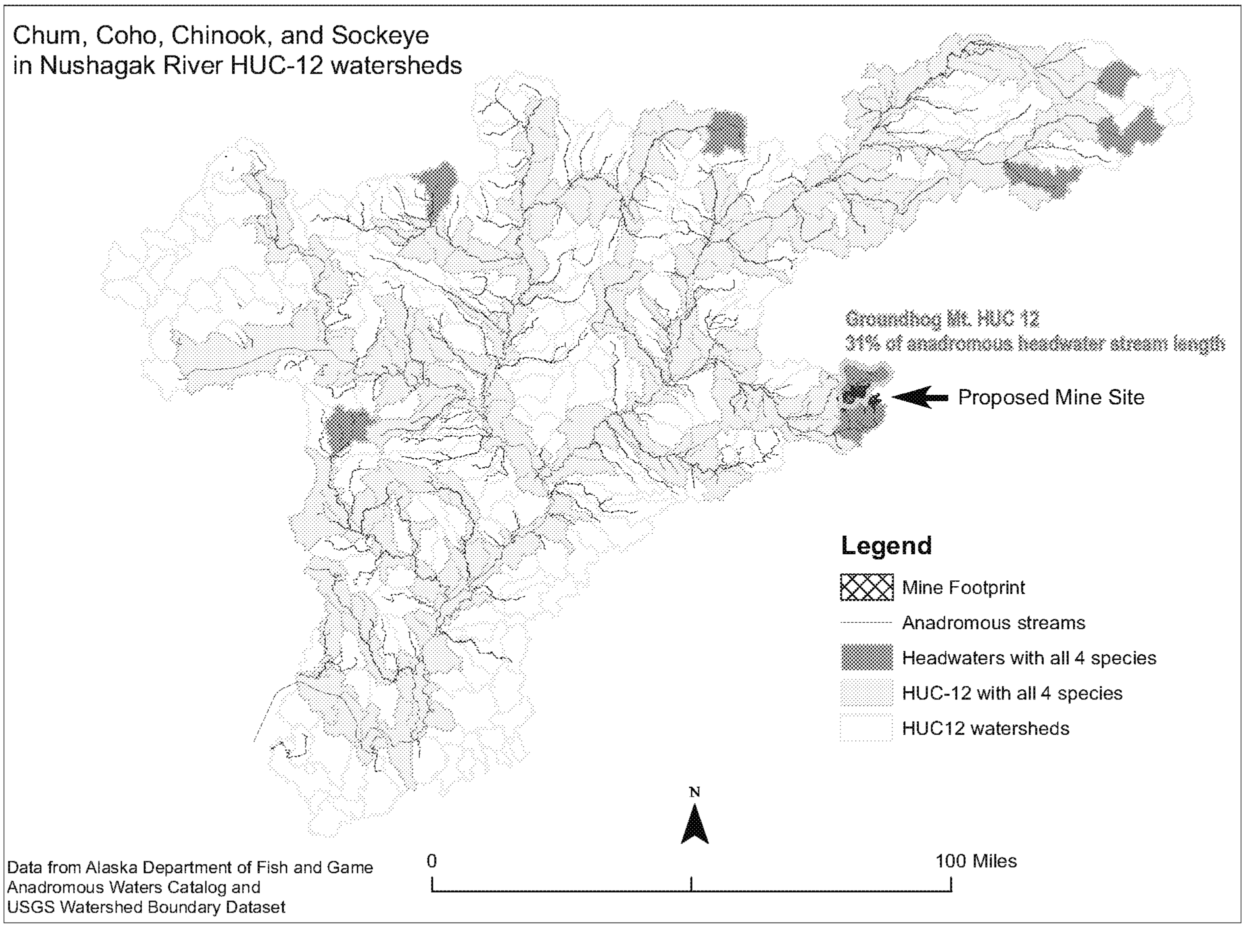

Figure 2. The Groundhog Mountain HUC-12 watershed (light blue outline), other HUC-12 headwater watersheds of the Nushagak River Basin that support four species of Pacific salmon (brown), other HUC-12 watersheds that support four species (green), HUC-12 watersheds (grey outline), and anadromous streams mapped by Alaska Department of Fish and Game (blue lines).

Conclusion

The Impervious Cover Model could be used in a 404(b)1 analysis of significant degradation at the site of the proposed Pebble Deposit mine. The ICM predicts that the impacts will cause streams in the 34,693-acre Groundhog Mountain HUC, a regionally and globally important fishery area, to become classified as "non-supporting". This prediction could be used as support for a finding of significant degradation, denial of a Clean Water Act section 404 permit, and for the No Action alternative of the Pebble Project DEIS. Given the high level of unavoidable impacts to this important fishery area that were found using a conservative analysis any other decision concerning significant degradation appears to be unsupportable.

LITERATURE

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